



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/866,665	05/30/2001	Takaharu Kondo	35.C15382	5130
5514	7590	07/08/2004	EXAMINER	
FITZPATRICK CELLA HARPER & SCINTO 30 ROCKEFELLER PLAZA NEW YORK, NY 10112			MUTSCHLER, BRIAN L	
			ART UNIT	PAPER NUMBER
			1753	
DATE MAILED: 07/08/2004				

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/866,665	<b>Applicant(s)</b> KONDO ET AL.	
	<b>Examiner</b> Brian L. Mutschler	<b>Art Unit</b> 1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 10 May 2004.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-15 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on May 10, 2004, has been entered.

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-7 and 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (U.S. Pat. No. 5,571,749) in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), herein referred to as US '749, US '264 and US '794, respectively.

US '749 discloses a method for producing silicon thin films, particularly for use in solar cells, using high-frequency plasma CVD (col. 15, line 9). US '749 discloses forming i-type silicon thin films using a material gas comprising silicon fluoride, hydrogen and oxygen (col. 15, lines 36-53; col. 33, line 60; col. 34, line 12). The flow

Art Unit: 1753

rate of the hydrogen is usually much higher than the flow rate of the silicon containing gas (see Tables 1-5). The examples shown in US '749 are formed at pressures higher than 50 mTorr (Tables 1-5). US '749 further discloses the use of oxygen-containing gases in the material gas mixture (col. 15, line 34).

The method and thin film of US '749 differs from the instant invention because US '749 does not disclose following:

- a. The step of adding oxygen to the material gas, as recited in claims 1, 4, and 10;
- b. The concentration of oxygen contained in the material gas is 0.1 to 0.5 ppm based on a concentration of silicon atoms, as recited in claims 1, 4 and 10; and
- c. The silicon thin film contains oxygen atoms at a concentration of from  $1.5 \times 10^{18}$  atoms/cm<sup>3</sup> to  $5.0 \times 10^{19}$  atoms/cm<sup>3</sup>, as recited in claims 5 and 11.

Regarding claims 1, 4, and 10, US '794 and US '264 teach methods for reducing the oxygen concentration in the layers of silicon thin films using molecular sieves or zeolites to adsorb oxygen when forming i-type layers solar cells having pin junctions (US '264 col. 6, line 20). US '264 teaches the formation of an i-type silicon thin film layer having an oxygen concentration less than  $5.0 \times 10^{19}$  atoms/cm<sup>3</sup> and as low as  $5.0 \times 10^{18}$  atoms/cm<sup>3</sup> (col. 6, line 26). US '794 teaches the formation of an i-type silicon thin film less than  $5.0 \times 10^{18}$  atoms/cm<sup>3</sup> or as low as  $5.0 \times 10^{15}$  atoms/cm<sup>3</sup> (col. 8, line 62; col. 9, line 44).

Regarding claims 5 and 11, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film of US '749 to use a thin film having an oxygen concentration of  $1.5 \times 10^{18}$  atoms/cm<sup>3</sup> to  $5.0 \times 10^{19}$  atoms/cm<sup>3</sup> as taught by US '264 and US '794 because oxygen in the intrinsic layer of solar cells act as donor centers and decreases the photo-sensitivity of solar cells (US '794 col. 3, lines 19-42).

Claims 5 and 11 are product-by-process claims, and as such, if the product is the same as or obvious from a product of the prior art, the claim is unpatentable (see MPEP § 2113). Since all of the references teach the use of a CVD method and US '794 and US '264 disclose the oxygen concentration in the final product, the instant claims would have been obvious over the prior art.

Furthermore, in light of the fact that US '794 and US '264 teach the formation of silicon layers having the specified oxygen concentration, and because the oxygen concentration that is deposited is dependent on the concentration contained within the material gas, it would have been inherent in the fabrication process of US '794 and US '264 to have used a material gas with an oxygen concentration of 0.1 to 0.5 ppm based on the concentration of silicon atoms. Using the specified process, a different oxygen concentration would have yielded a different concentration of oxygen in the deposited layer.

Regarding the step of adding oxygen to the material gas as recited in claims 1, 4, and 10, the separation of the steps amounts to a rearrangement of the process steps.

Art Unit: 1753

Instead of providing a gas containing silicon fluoride and hydrogen and then adding oxygen, the prior art teaches that the oxygen is already present in the gas containing silicon fluoride and hydrogen. The selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. See *In re Burhans*, 154 F.2d 690, 69 USPQ 330 (CCPA 1946). As indicated in the instant disclosure, "the oxygen may be added by separately introducing oxygen from an oxygen cylinder," or "alternatively, a high amount of oxygen is previously contained in a material gas cylinder and/or a dilute gas cylinder" (see page 25 at lines 1-5).

4. Claims 8 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (U.S. Pat. No. 5,571,749) in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), as applied to claims 1-7 and 10-13, and further in view of JP 2000-77694. References to JP 2000-77694 are made using the column and line number references of Higashikawa (U.S. Pat. No. 6,252,158), herein referred to as US '158, which is the U.S. patent in the JP 2000-77694 patent family.

US '749, US '264 and US '794 disclose a method and silicon thin film having the limitations recited in claims 1-7 and 10-13 of the instant invention, as explained above in section 3. The method and device described by US '749, US '264 and US '794 further differs from the instant invention because they do not disclose having a crystalline Raman scattering at least three times greater than the Raman scattering due to amorphous components.

Raman scattering shows the level of crystallization within silicon layers. The ratio of crystalline component to amorphous component gives a measurement for the crystal volume within the layer, i.e., a film having a crystalline component with a Raman scattering three times greater than the Raman scattering of the amorphous component has a crystal volume of 75%.

US '158 teaches a solar cell structure having several microcrystalline intrinsic layers with crystal volumes ranging from 30% to 99% (col. 11, line 66 to col. 12, line 3). Microcrystalline silicon solar cells avoid "the optical degradation phenomenon (Staebler-Wronski effect) specific to the amorphous semiconductors" (col. 2, lines 47-52).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film described by US '749, US '264 and US '794 to use a thin film having a crystalline Raman scattering three times greater than the amorphous Raman scattering, as taught by US '158, because a higher crystalline Raman scattering helps avoid the deleterious effects of optical degradation associated with amorphous semiconductors (US '158 col. 2, lines 47-52).

5. Claims 9 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (U.S. Pat. No. 5,571,749) in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), as applied to claims 1-7 and 10-13, and further in view of JP 11-310495. References to JP 11-310495 are made using the column and line number references of Kondo (U.S. Pat. No. 6,103,138), herein referred to as US '138, which is the U.S. patent in the JP 11-310495 patent family.

US '749, US '264 and US '794 describe a method and silicon thin film having the limitations recited in claims 1-7 and 10-13 of the instant invention, as explained above in section 3. The silicon film described by US '749, US '264 and US '794 further differs from the instant invention because they do not disclose having a diffraction intensity of the (220)-plane comprising at least 50% of the total diffraction intensity.

US '138 teaches the use of thin films having diffraction intensities in the (220)-plane at least 30% of the total diffraction intensity because "the thin film will have notably improved carrier mobility" (col. 3, lines 37-40). US '138 further discloses specific examples of thin films having diffraction intensities in the (220)-plane from 50% to 60% relative to the total diffraction intensity (table 2).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the thin film of US '749, US '264 and US '794 to use a thin film having a diffraction intensity in the (220)-plane at least 50% of the total diffraction intensity, as taught by US '138, because using such a thin film will have a "notably improved carrier mobility" (US '138 col. 3, lines 37-40).

### ***Double Patenting***

6. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double



Art Unit: 1753

patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

7. Claims 1-7 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4 of U.S. Patent No. 6,706,335 in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), herein referred to as US '335, US '264 and US '794, respectively.

Additional evidence regarding silicon fluoride gases is provided by "Silicon Tetrafluoride" found at <http://www.scottsemicon.com/pures/sif4.html>.

Claims 1-4 of US '335 claim a method of forming a silicon thin film formed using a silicon halide and hydrogen, wherein the silicon halide is a silicon fluoride. Claim 3 recites the limitation that the flow rate of hydrogen is not less than the flow rate of the silicon halide. Claim 4 recites the limitation that the pressure is 50 mTorr or more.

US '335 differs from the instant invention because US '335 does not disclose adding oxygen to a material gas containing silicon fluoride and hydrogen, as recited in claims 1 and 4; having oxygen present in the material gas at a concentration or from 0.1 ppm to 0.5 ppm, as recited in claims 1 and 4; and a oxygen concentration in the formed silicon film having a concentration of  $1.5 \times 10^{18}$  atoms/cm<sup>3</sup> to  $5.0 \times 10^{19}$  atoms/cm<sup>3</sup>, as recited in claim 5.

US '794 and US '264 teach methods for reducing the oxygen concentration in the layers of silicon thin films using molecular sieves or zeolites to adsorb oxygen when forming i-type layers solar cells having pin junctions (US '264 col. 6, line 20). US '264

Art Unit: 1753

teaches the formation of an i-type silicon thin film layer having an oxygen concentration less than  $5.0 \times 10^{19}$  atoms/cm<sup>3</sup> and as low as  $5.0 \times 10^{18}$  atoms/cm<sup>3</sup> (col. 6, line 26). US '794 teaches the formation of an i-type silicon thin film less than  $5.0 \times 10^{18}$  atoms/cm<sup>3</sup> or as low as  $5.0 \times 10^{15}$  atoms/cm<sup>3</sup> (col. 8, line 62; col. 9, line 44).

Regarding claim 5, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film of US '335 to use a thin film having an oxygen concentration of  $1.5 \times 10^{18}$  atoms/cm<sup>3</sup> to  $5.0 \times 10^{19}$  atoms/cm<sup>3</sup> as taught by US '264 and US '794 because oxygen in the intrinsic layer of solar cells act as donor centers and decreases the photo-sensitivity of solar cells (US '794 col. 3, lines 19-42).

Claim 5 is a product-by-process claims, and as such, if the product is the same as or obvious from a product of the prior art, the claim is unpatentable (see MPEP § 2113). Since all of the references teach the use of a CVD method and US '794 and US '264 disclose the oxygen concentration in the final product, the instant claims would have been obvious over the prior art.

Furthermore, in light of the fact that US '794 and US '264 teach the formation of silicon layers having the specified oxygen concentration, and because the oxygen concentration that is deposited is dependent on the concentration contained within the material gas, it would have been inherent in the fabrication process of US '794 and US '264 to have used a material gas with an oxygen concentration of 0.1 to 0.5 ppm based on the concentration of silicon atoms. Using the specified process, a different oxygen

concentration would have yielded a different concentration of oxygen in the deposited layer.

Regarding the step of adding oxygen to the material gas as recited in claims 1 and 4, the separation of the steps amounts to a rearrangement of the process steps. Instead of providing a gas containing silicon fluoride and hydrogen and then adding oxygen, the prior art teaches that the oxygen is already present in the gas containing silicon fluoride and hydrogen. The selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. See *In re Burhans*, 154 F.2d 690, 69 USPQ 330 (CCPA 1946). As indicated in the instant disclosure, "the oxygen may be added by separately introducing oxygen from an oxygen cylinder," or "alternatively, a high amount of oxygen is previously contained in a material gas cylinder and/or a dilute gas cylinder" (see page 25 at lines 1-5).

8. As a source gas, US '335 defines silicon tetrafluoride as one of the gases that may be used (col. 8, lines 4-17). Silicon tetrafluoride gas typically contains some oxygen gas. For example, Scott Semiconductor Gases provides semiconductor grade silicon tetrafluoride that contains less than 20 ppm of argon + oxygen (see "Silicon Tetrafluoride" found at <http://www.scottsemicon.com/pures/sif4.html>). Therefore, it appears that the material gas of US '335 would more than likely contain at least some oxygen.

***Response to Arguments***

9. Applicant's arguments filed May 10, 2004, have been fully considered but they are not persuasive.

10. As indicated above, the separation of the addition of adding oxygen to the material gas is a rearrangement of steps that does not have any impact on the process of forming a silicon-based thin film by high-frequency plasma CVD. Therefore, the rearrangement of steps is an obvious variation of the method taught by the prior art of record.

***Conclusion***

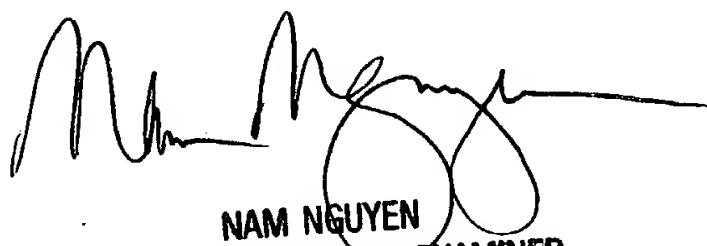
11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (571) 272-1341. The examiner can normally be reached on Monday-Friday from 7:30am to 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 1753

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BLM  
July 2, 2004



NAM NGUYEN  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700